The enigma of testing patchcords

INTRODUCTION

Challenges in testing patchcords arise in part due to the confusion in the specified accuracies of the testers being used at cable and/or patchord manufacturers. To remove ambiguities, AESA has specially developed patchcord adapters that coupled with its Cobalt ATE, provide meaningful measurement with the highest accuracy.

SHEDDING LIGHT ON THE MEASUREMENT OF PATCHCORDS

Although field testers are by definition used to test the installed network, the same test equipment is utilised in the production chain at component level, especially for patchcords. However, some misinterpretation could arise due to different requirements in standardisation.

Cable manufacturers produce 100m cables according to *IEC 61156-6 (see Table 3)*. Afterwards they sell their cables to patchcord assembly manufacturers which test patchcords with lengths ranging from 0.5m to 20m.

This usually leads to the following challenges and open questions:

- What happens if the patchcord fails on the field tester?
- Who is responsible?
- Who has to verify the performance?
- What is the reference method?

Normally the patchcord assembly manufacturer has only a field tester to verify the performance of a patchcord. In case of test failing, the only option is to send the patchcord to the cable manufacturer for cross-checking. The cable manufacturer will perform the similar test on a field tester. However, probability that he gets different results than the patchcord assembly manufacturer is high due to variations linked to measurement repeatability and reproducibility.

Minimal accuracy requirements for field testers are defined in *IEC 61935-1*. Depending on the test system used, i.e. balun- or balunless-based, the standard sets the reference methods for comparison purposes along with maximum allowed deviation:

- Balun based → *IEC 61935-1*
- Balunless based → *IEC TR 61156-1-2*

For Class E_A/Cat6_A cables, accuracy values for NEXT and RL parameters are given in Table 1 below. These values are defined in IEC 61935-1 for permanent link. They represent the worst case scenario, i.e. for a permanent link length of 15m.

Test parameters	Link accuracy at permanent link limit (Class E_A/ Cat6_A) [dB]		
	100MHz	250MHz	500MHz
NEXT	2.3	3.6	4.6
RL	3.5	4.3	4.5

Table 1: Field tester link accuracy requirements (IEC 61935-1)

For comparison, the accuracy of AESA Cobalt Automated Test Equipment (ATE) is given in Table 2. It shows much tighter specifications than the standards in Table 1.

Test parameters	Cobalt interface accuracy on the limit line [dB]		
	100MHz	250MHz	500MHz
NEXT	1.2	1.4	1.8
RL	0.7	0.9	0.8

Table 2: Cobalt accuracy

Unfortunately, in the case of patchcord, the corresponding IEC 61935-2 does not provide any accuracy limits (see Table 3).

	Cable manufacturer	Patchcord assembly manufacturer
Component specification	IEC 61156-6 100m	ISO/IEC 11801-1 0.5m…20m
Test method	VNA	Field tester
Accuracy specification	Reference method → According to manufacturer	IEC 61935-1 → Channel, Link IEC 61935-2: no specification
Reference procedure	IEC 61935-1 → balun based IEC TR 61156-1-2 → balunless	

Table 3: Standards landscape

<u>Hence, why do we refer these test parameters to a permanent link?</u>

As stated above, there is no maximum allowed deviation specified for patchcord testing in IEC 61935-2. The permanent link measurement is the setup the closest to patchcord measurements even if the length is different. Nevertheless, patchcords are specified for lengths of 0.5m up to 20m. Therefore, especially for short patchcord for which RL and NEXT measurements are more challenging due to the larger impact of the terminations, it has to be assumed that results will be worse than the accuracy specified in Table 1 for field tester.

<u>What AESA can bring in to clarify the situation?</u>

AESA recently developed patchcord adapters fitting to its Cobalt ATE standard interface (see Fig. 1 below. It consists of 4 bare wire connection pairs separated by 90° each. This setup allows for a fast change between cable and patchcord measurement.
The test setup has 2 symmetrical adapters with the connection between the Cobalt standard interface and the RJ45 jack.

Measurements for a 1m Cat6_A patchcord are illustrated in Fig 2.

These results could only be obtained thru the use of our Cobalt ATE with high intrinsic accuracy (see Table 2) and a careful design and optimization of the adapters. Last but not least, significant improvements were reached solely with RL and NEXT de-embedding, a new extended calibration method and a new VNA.

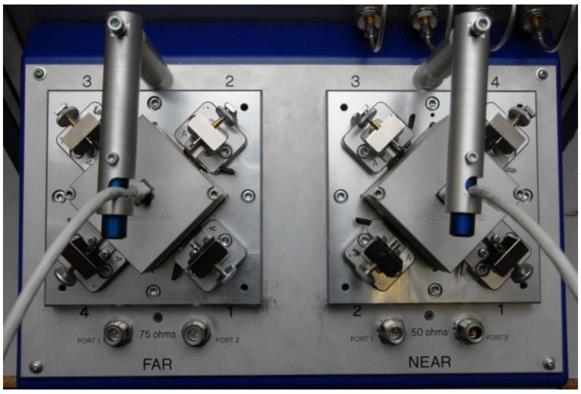
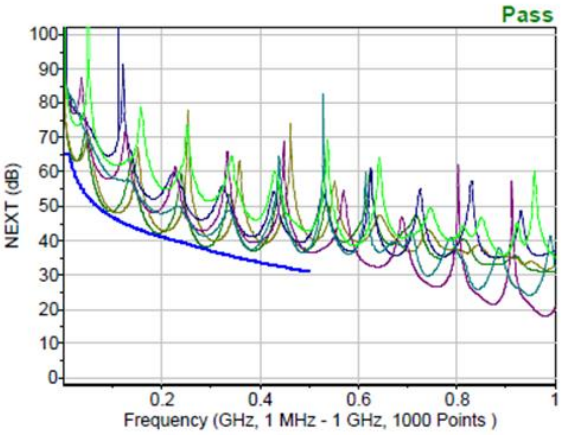
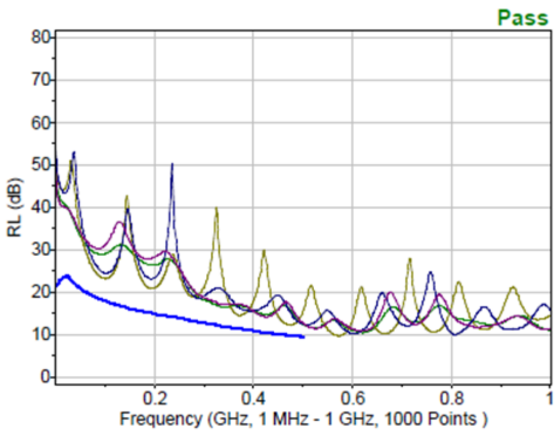


Figure 1: Patchcord adapters Cat6_A on a Cobalt standard interface



NEXT 1m patchcord



RL 1m patchcord

Figure 2: Example of a Cobalt measurement on a 1m Cat6$_A$ patchcord

CONCLUSION

By introducing of a reference test system, AESA fills the gap in the discussion between the cable and the patchcord assembly manufacturers. In case of discrepancies between the results of the patchcord assembly manufacturer and the cable manufacturer, the reference equipment of AESA delivers the highest accuracy to judge critical products on the limit line, as demonstrated in the example here above.

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